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This study of musicology develops computer programs, data, and procedures for using the computer in the field of thematic indexing. The thematic index is a means of identifying anonymous works, arranging and cataloging the works of a particular composer or genre, and collating the varied manuscript and printed sources of a particular form or style. Automated procedures make it possible to carry out more sophisticated analyses of larger repertories than is possible by hand. The opening melodies, or incipits, from various 16th century repertories were coded into computer language using the Ford-Columbia Representation method. Programs were written to analyze, extract, and print data in varying formats from the more than 30,000 incipits encoded. Conclusions are (1) that thematic indexing can be carried out successfully on a large scale by use of the computer, (2) the idea of a data bank of research materials has great value, (3) ways must be found to incorporate the factor of rhythm into future studies, (4) a means of printing the actual music as part of the computer format is needed, and (5) further investigation is needed to determine the most effective ways to publish the results of automated thematic indexing. (TT)

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DEVELOPMENT OF COMPUTERIZED TECHNIQUES IN MUSIC RESEARCH WITH EMPHASIS ON THE THEMATIC INDEX

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November 1968

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Acknowledgments

The research described in this report could not have been carried out without the cooperation and professional help of various persons. Valuable suggestions were provided by several of the musicologists and music librarians who attended the Conference on Thematic Indexing described in this report. Knowledgable assistance was provided by Mr. Christian Granger in the preparation of materials for the computer and by Mrs. Mary Anthony who worked skillfully from microfilms of sixteenth-century materials and prepared several thousand index cards. None of this material could have been successfully processed by the computer without the sophisticated programming and organizational abilities of Mrs. Cay Gill, academic programmer in the Computer Center of the State University of New York at Binghamton.

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SUMMARY

The purpose of this research was to develop computer programs, necessary data, and procedures for using the computer in a special field of musicology known as thematic indexing, and to explore the use of these techniques in other areas of music. The project was not concerned with the use of the computer in music composition.

The thematic index has been used for over fifty years in music research as a means of identifying anonymous works, arranging and cataloging the works of a particular composer or genre, and for collating the varied manuscript and printed sources of a particular form or style. When done by hand the thematic index entails an enormous amount of effort in the preparation and sorting of thousands of cards. This has limited past efforts to small repertories and to very restricted publication of results of this work. By developing automated procedures it is possible to deal with vast repertories, to develop far more sophisticated analysis of data, and to print the results in meaningful formats.

Because music has its own written language, i.e. the staff and notation, it is first necessary to translate that language into the letters and numbers which the computer can read and process. For this project the investigator used the Ford-Columbia Representation, originally developed by other researchers for a project in music graphics.

The investigator has concentrated on music of sixteenth-century Italy as an extension of his earlier research interests. The earlier pilot-project concentrated on the 1000 pieces known as the frottole. The opening melody, or incipit, for each of the four voice parts of each piece was encoded giving a total of 4000 incipits. Programs were written to extract the interval sequence from each incipit. In developing each sequence a +2 indicates the melodic interval of an ascending second, a -2 a descending second, +3 ascending third etc. The full sequence, through seven intervals, can be ordered in a number of ways by the computer to permit citations of duplications, borrowings, and similar information of importance to the music historian and theorist.

Under the present project more than 30,000 incipits were encoded from various sixteenth-century repertories. Programs have been written to extract and print data in varying formats, as shown in examples appended to the full report.

The investigator has reported on this work in articles in Computers and Humanities, Computers and Humanistic Studies, and Elektronische

Datenverarbeitung in der Musikwissenschaft. As a result of this research, the necessary materials were prepared for a book to be titled Indices of the Frottole Repertory.

Part of the funds for this project were expended to sponsor a Conference on Thematic Indexing, held in Washington, D.C., on November 4, 1967, and attended by 24 musicologists and music librarians. From this meeting came valuable suggestions to the investigator and agreements for cooperation among the participants. Since the meeting four of the participants have submitted material for the data bank of incipits being developed at the State University of New York at Binghamton.

BACKGROUND FOR THIS RESEARCH PROJECT

The thematic index, in its many forms, has long been a common tool for musicological research. It is a listing of the opening themes of the complete works of a particular composer, or, more rarely, of a particular genre, and usually consists of the first seven to twelve notes, known as the incipit. It serves several functions to the researcher, functions analagous to those of concordances and indices of first lines of poetry in the field of literature. It also provides data for the analysis of musical style or changes in style of a composer or genre.

As developed by traditional methods, the thematic index is limited in its uses and applications. Traditional or "hand" methods of development include the preparation of elaborate card files, lists, catalogs etc. With small repertories these can be manageable, but with larger bodies of material they become completely unwieldly. Publication of the results of the research calls for setting of type and autographing the music, both expensive processes.

A small number of musicologists have realized that the whole system would lend itself to automation. The necessary research to develop automated procedures calls for time, effort, ideas, and financial support. The present research project is the most ambitious by far of any attempted in this area in American or European musicology.

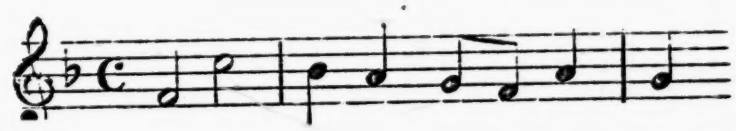
Prior to the present research, the investigator developed a small pilot project to test the feasibility of using the computer for indexing and analysis. The sixteenth-century Italian vocal repertory known as the frottole served as material for this study. In carrying out the pilot study, attempts were first made to encode music for the computer by simply entering the letter names of the notes of a melody. It became apparent that while this would provide data quickly for very limited computer analysis, it did not take rhythm into consideration and thus would be of little value for other studies. During the pilot project stage it was decided to use a music representation known as the Ford-Columbia Representation for encoding melodies. This representation, developed by Mr. Stefan Bauer-Mengelburg, President of Mannes College, was intended for a project in music graphics. Although this work in the printing of music remains unfininshed, the music representation has become accepted as an excellent tool for music analysis and indexing by several researchers. The Ford-Columbia representation is discussed more fully in the description of the present research below.

The following steps were carried out in the pilot project:

1. The 4000 incipits of the frottole repertory (from 1000 four-voice pieces) were encoded and keypunched in the Ford-Columbia Representation. Each piece was identified by a six-digit serial number and the investigator's initials. The use of initials will permit quick identification and separation of repertories contributed by other researchers.

2. One thousand cards containing basic information (composer, title, etc.) for each piece were keypunched.

3. A computer program was written which extracted the interval sequence from the Ford-Columbia Representation. Example 1 illustrates the generation of this information. Below the example the Ford-Columbia Representation is shown and on the following line the computer-generated set of numbers describing the interval sequence. Repeated notes are not considered for the important reason that a composer may, for example, borrow a melody and may change a whole note to two half notes in order to accommodate a new text. Our interest is in the over-all contour of the melody.



!G !K1- !MC 2H 6 / 5Q 4 (3 2) 4Q / 3Q
+5 -2 -2 -2 -2 +3 - 2

4. The interval sequences were arranged in numerical order. Groups of identical sequences were single spaced in the printout. A double space separated the identical groups. This permits quick identification of matching contours. The data from the basic information cards, stored on computer disk, was matched by serial number and printed with the interval sequence.

5. In each group of matching contours a check of the Ford-Columbia Representation or the original music provided confirmation of genuine matches.

The pilot project showed that heretofore unidentified duplications and borrowings in the frottole repertory do indeed exist and proved the feasability of applying these techniques to much larger repertories. The investigator reported on the pilot study in a paper to the American

Musicological Society's annual meeting at New Orleans in December 1966.

It was at this time that application was made to the Office of Education to continue development of computer techniques in music research. The main body of this report which follows describes the work carried out under the one year (1968-1969) grant from the Office of Education.

RESEARCH PROCEDURES OF THE 1967-1968 PROJECT

Several procedures were carried out simultaneously during the year. Briefly these were:

1. Acquisition, encoding and keypunching of data.

2. Writing of programs to permit computing of greater varieties of information than obtained in the pilot project and to permit more effective formats in the computer print-outs.

3. Continuous study and comparison of print-outs with original music to determine effectiveness of the research design.

4. Merging of materials submitted by other researchers with that already developed by the investigator. This cooperation among researchers means that a "data bank" of thematic incipits is being developed which can be used by the profession at large.

These four areas are considered now in detail:

1. Acquisition, encoding and keypunching of data.

The music encoded came from microfilms of original sixteenth-century sources or modern printed editions. Most of the printed editions used to date are in the music library at the State University of New York at Binghamton. Microfilms were purchased from abroad by the general university library as part of the matching funds for the project. One concentration has been on early sixteenth-century materials with emphasis on the madrigal repertory. In addition some materials from early sacred music works were encoded because of ease of availability in modern editions. One of the largest single body of materials encoded was the complete works of Palestrina, a major composer of the century.

A serial number was assigned to each composition. A log of these serial numbers is hand entered in a volume of 50,000 computer-printed numbers. Appendix A illustrates a page of this

log. The numbers were printed 500 to a page to permit quick searching.

Appendix B lists, in a compact and abbreviated format, the works encoded to date. Full titles are not given for microfilm materials. For these works the number assigned by the RISM catalog (Repertoire International des Sources Musicale) are given with the knowledge that researchers interested in identifying these collections will have the RISM catalog at hand. The typical entry under each RISM number will include thirty to forty pieces and about 150 incipits. The modern printed collections are often much longer. Included in the listing are several thousand incipits from the Alfred Einstein microfilms in the Smith College Library. The difficult work of reading and encoding these films was done by a graduate assistant, Mrs. Mary Anthony.

2. Writing of programs to permit computing of greater varieties of information than obtained in the pilot project and to permit more effective formats in the computer print-outs.

The work in this category was done as a close collaboration between the investigator and Mrs. Cay Gill, academic programmer in the Computer Center at State University of New York at Binghamton. The investigator outlined the specific information desired from the data and, in a sense, translated the musical problems into problems involving the manipulations of alphanumeric information. The data is entered from two major source decks of cards, the Ford-Columbia Representation and the cards of basic information on composer, title etc. These are stored on tape or disk. The first program, a revised version of one written for the pilot project, computes the interval sequences and sorts them in numerical order. Each interval sequence is then printed along with the corresponding representation and basic information, all "called" from computer storage. The identifying device common to these various sources is the serial number of the piece and the voice code. (For example, 0104 stands for the first voice of four, i.e. the soprano; 0204 would be the second voice, or alto, etc.)

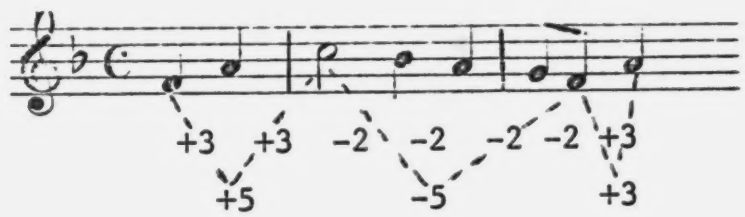
Appendix C illustrates a page of computer printout showing the information generated from this basic program. (This is one of some 1200 pages of printout from this program.)

The cards containing information on composer, title and other details about each composition provide subsidiary indices of value to researchers. Professor Joel Newman of Columbia University provided the investigator with tables of contents of several collections of Italian madrigal verses from the sixteenth-century. Madrigal composers often took their texts from these madrigal collections but did not bother to identify the author of the

madrigal. By merging the titles from the poetry collections with the titles of madrigals a data bank of text sources has been started. This project will be expanded in the future. A sample page of the computer print-out from this program is shown in Appendix D.

Several other musicologists have contributed indices to the project in order to expand the data bank on the Binghamton campus and to provide themselves with useful research information. At first it was assumed that contributing researchers would follow the exact formats used by the investigator in preparation of materials. It soon became apparent however, that this was an unreasonable restraint to impose on other researchers and it became necessary to modify the formats for inputing data. Mrs. Gill devised a system of programs and input instruction codes which a guest researcher uses in fromt of his data to tell the computer how to work with his particular format. Appendix E is the set of instruction sheets for use by other researchers in preparation and submission of materials for the central data bank.

Near the end of the project year a beginning was made on two other programs, which, when fully developed, will expand the power of the indexing procedures. These two programs were written by the investigator's graduate assistant, Christian Granger, who joined the computer center as programmer near the end of this project period. The first of these is a program to compute the broad contour of a melody. Referring again to the melody on page 7 one can imagine a borrowing of this melody in which the large upward interval at the beginning of the melody was filled in by the composer utilizing this theme. The resulting melody might appear as follows:



The detailed contour of this melody (+3+3-2-2-2-2+3) does not correspond to the contour shown in example 1. Yet it is apparent that the two melodies are similar. However, the overall contour,

or broad contour is the same for the two melodies and is shown by the intervals +5-4+4. Appendix F shows the results of the first program written to extract the broad contours from the detailed contours of each incipit. Future programs will order the broad contours in a manner permitting citation of similar melodies.

Sometimes a melody is borrowed and changed by one interval only. This is another form of similar as opposed to identical contour. A merit factor can be assigned to a comparison of two contours. For example the factor 10 might be assigned if two contours are identical. The factor 9 would be assigned if one interval differed, an 8 if two intervals differ. Appendix G illustrates the first effort at assigning merit factors to a comparison of one interval sequence with hundreds of others.

Work will continue in refining the above programs and in developing others to permit a wider variety of studies of melodies.

3. Continuous study and comparison of print-outs with original music to determine effectiveness of the research design.

Final confirmation of a borrowing or duplication in a repertory depends on a comparison of the original music of the two pieces in question. With the repertory of the pilot project, a group of 1000 compositions, this has been manageable by simply turning to the investigators xerography copies of the original frottole books. With larger or more diffuse repertories this procedure becomes less successful. In the early stages of the pilot project it was expected that use would be made of either Xerox Semi-Micro cards or of micro-aperture cards. Both systems permit machine handling and sorting of cards on which a copy of the original music appears in film or in a xerographic reduction. In practice these systems have not proved feasible because of expense, limited availability of equipment, and because, in practice, the techniques were found to be clumsy when used with music. Two solutions to this problem are possible. The first, which has been carried out with about 1/4 of the material encoded, involves copying the incipit on to a data card and later using the computer to enter the incipit interval sequence on to the same card. When the cards are sorted according to interval sequences a quick check of a group of cards having the same sequence shows which melodies are indeed identical or similar.

The second solution envisages a rapid method of printing the incipit in the original music staff and notation. This would be an ideal solution and may be achievable either by use of the computer plotter or by devising special type faces for the high speed computer printer. The intestigator began consultations near the end of the project with a plotter programmer at the computer center

of State University of New York at Buffalo and with typography experts at the IBM Corporation's Glendale Laboratory in Endicott, N.Y. Every effort will be made in the future to pursue these possible solutions to a vexing problem.

4. Merging of materials submitted by other researchers with that already developed by the investigator.

The research project described in this report has attracted widespread interest among musicologists interested in thematic indexing. A number of these persons have inquired about cooperation in submitting materials for the central data bank and for use of materials developed by the investigator. The following is a listing of these inquiries and the types of materials submitted by these researchers:

a. Professor Earle Hultberg, State University College, Potsdam, N.Y., has contributed a repertory of several hundred incipits of sixteenth-century Spanish lute music. He has worked closely with this investigator in developing programs which translate the special lute notation (known as tablature) into a Ford-Columbia representation of modern notation.

b. Dr. Benjamin Suchoff, Curator of the Bela Bartok Archives, New York City, has prepared an edition of Bela Bartok's study of Rumanian Folk Melodies in which the techniques developed in the investigator's pilot project were used to study several hundred of these melodies. The materials were key-punched under Dr. Suchoff's direction in New York and submitted to the computer at Binghamton for this work.

c. Professor Franklin Zimmerman, University of Pennsylvania, works with sixteenth-century Spanish manuscripts and has submitted about 125 incipits to the data bank for comparison with the other comparable materials already on file.

d. Professor Roland Jackson at Roosevelt University submitted a group of incipits from a late sixteenth-century Neapolitan manuscript source. These materials were under study at the close of the project period covered by this report.

In addition to the four principal research procedures outlined above, consultations were held with music librarians at Cornell and the New York Public Library. Automation of thematic indexing holds promise of greatly increasing materials for music library use and from the beginning of his work the investigator has consulted with music librarians for guidance and suggestions. It is hoped that the tools being developed by this project will provide the means for structuring of indices in a wide variety of repertories,

including folk music and popular music, to name two areas in which there are enormous bodies of material lacking systematic arrangement.

An important event financed by this project was the Conference on Thematic indexing held in Washington, D.C., on November 4, 1967. Twenty-three musicologists and music librarians, all with an interest in music indexing, were in attendance. The day's meeting was devoted to discussions of problems and prospects for automated indexing and to proposals for cooperation among indexers. The investigator gained valuable ideas for his research from this meeting as well as offers of cooperation in development of the central bank of incipits. Appendix H lists the participants in the Conference.

RESULTS OF THE PROJECT

1. A large body of sixteenth-century music materials has been encoded and will serve as test material for programs developed in the future. While some programs can be tested with small repertories it is very important to have larger quantities available to truly measure the validity of a procedure. The data bank of incipits encoded, keypunched, and stored on the Binghamton campus is by far the largest of its kind in the world today and is available for use by all music researchers. Expansion of this data bank continues both on this campus, when funds are avaiable and by contributions of other researchers.

2. Effective and successful programs have been developed for computing pertinent and useful information from the data bank of incipits. These programs have already been summarized above and include programs for interval extraction, various alphabetizing procedures, computation of broad contour from detailed contour and the merit function program.

3. Sufficient data has been gathered to prepare specific thematic indices for publication. A volume, Indices of the Frottole Repertory, is now under preparation. The volume is expected to demonstrate the usefulness of the computing procedures to the others in the profession and should generate interest in developing similar compendiums in other repertories. The investigator has had inquiries from persons working in such fields as folk music, hymnology, and popular music. The data bank at Binghamton has already processed a set of published indices, a recent edition of Bela Bartok's study of Rumanian Folk Songs edited by Dr. Benjamin Suchoff, curator of the Bela Bartok Archives in New York City.

It should be noted that the project is an on-going one and that this report covers the first year of an original three-year proposal. All the phases of the project already discussed--encoding, writing of programs, analysis of results--will continue in 1968-1969.

CONCLUSIONS AND RECOMMENDATIONS

1. The investigator concluded that thematic indexing on a large scale can be carried out only by use of the computer. Once materials are encoded, vast quantities can be computed and printed in a variety of formats with comparative ease.

2. Although the project began as a study using materials gathered by the investigator it has become increasingly evident that the idea of a data bank of materials from any number of researchers has great value. The fact that in the first year of this work there have been four active contributors to the data bank and several other inquiries evidence of the importance of continued attention to this phase of the effort. It should be noted that the computing center at State University of New York at Binghamton has been very generous in processing these materials which are outside the scope of the original proposal but which have contributed greatly to the effectiveness of the study.

3. The single most important problem which arose during the project is the need for a means of printing the actual music (not just the alphanumeric representation of the music) as part of the printout format. To accomplish this will require programming of the computer plotter and/or development of special type faces for the high speed printer. The investigator has been assured of cooperation from the computer center of the State University of New York at Buffalo for development of programs using the computer plotter as a means of drawing the staff and notation from the Ford-Columbia Representation. At the close of the project period conversations were begun with experts at the Glendale Laboratory of the IBM Corporation in Endicott, N.Y. to investigate the feasibility of developing special type faces for music. If support can be found during the 1968-1969 academic year it is hoped to acquire these special type characters and to begin programming them for printing music on the computer.

4. Although the programs for interval extraction and for ordering interval sequences have proved successful it is still apparent that ways must be found for incorporating the factor of rhythm into any study. This must involve the development of measurements of both rhythm and contcur in a manner permitting ordering of both these measurements. Near the close of the contract period the investigator

began work on the concept of melody as "wave form" and is convinced that by incorporating the techniques of pattern recognition under study in other areas it will be possible to develop precise ways in which to find any two matching melodies amongst thousands in a data bank.

5. Finally, further investigation is needed on determining the most effective publication of the results of automated thematic indexing. The potential uses of the plotter and of special type fonts, discussed in number 3 above, will permit great flexibility. Theoretically it will be possible within a few years to access the Binghamton data bank from any place in the country by means of terminals and telephone lines. At present rates this is expensive. The investigator has consulted with music librarians on the relative merits of regularly updated computer printouts, publication of hardbound books of incipits for particular repertories, or the development of computer-printed sets of standard (3" x 5") cards to be supplied to music libraries for catalogue of indices easily accessible to scholars. At present it is too soon to make a firm decision to move in any one direction and the investigator is developing his materials in a manner to permit future flexibility.

Appendix A Log for entry of serial numbers assigned to collections

[Einstein, cont'd]

41–52 FERRARI
CANZONNETTE
1600

53–74 FERRETTI
2nd bk
Canzonette
1574
B ✓

75–205 VOL 19
FIESCO
MUSICA NOVA
1569
B ✓

206–304 FLECCIA -
1st bk
Madrigali
1568
B ✓

7321–7333
7334–7355 VOL 20
FLORIO -
1st bk
mad -
1589
B ✓

7356–7384 Fogliano
Madrig
Rism
1547/16
B ✓

7385–7400 FONTANA -
CANZONA
VILLANESCHE
1545
B ✓

7401–7407
7408–7429 VOL 21
Gabrieli -
2nd Bk-mad-6
1580
B ✓

7430–7459 GABRIELI
1st Bk
mad-5
1566
B ✓

7460–7480 VOL 22
Gabrieli -
2nd Bk MAD-5
1570
B ✓

7481–7487
7488–7500 GABRIELI
GREGESCHE
ET JUSTINIANE
1571
B ✓
P ✓

APPENDIX B List of works encoded

1. The Frottole Repertory (RISM 1504/4, 1505/3, 1505/4, 1505/5, 1505/6, 1506/3, 1507/3, 1507/4, 1508/3 1509/2, 1514/2, 1516/2, 1617/1 1517/2, 1517/3, 1519/4, 1520/7, 1526/6, 1531/4.

2. Madrigal and sacred music collections listed in RISM

1505/2	1547/16
1536/6	1547/21
1536/7	1550/19
1537/7	1557/18
1539/23	1559/19
1539/24	1564/16
1541/9	1570/17
1541/14	1583/19
1541/16	1586/9
1542/17	1589/12
1543/19	1591/21
1544/16	1594/11
1544/14	1621/18
	1640/2

3. Incipits encoded from modern editions

CMM (Corpus Mensurabilis Musicae)
- CMM 3 - A. Willaert
- CMM 7 - J. Barbireau
- CMM 10 - Gafurius
- CMM 14 - C. Rore
- CMM 26 - Vincentino
- CMM 31 - Arcadelt
- CMM 25 - C. Festa

Jeppeson - Italia Sacra

Palestrina, complete works edited by Casimiri (30 volumes)

4. Incipits from the Einstein microfilm collections (of transciptions by Einstein) in Smith College Library.

```
|G |MC|                RC 6Q 6F 7 8QJ / 8 8 (9. ((8 ) ((7 8 9 7))

GPALEST    BEATAE MARIAE VIRGINIS II                    CASIMIR  18/126
|G |MC|                RW / RH RQ 4Q / 5Q. 6E 7Q (6 5) / 6Q 7

GPALEST    BEATAE MARIAE VIRGINIS II                    CASIMIR  18/126
|F |MC                 RW / RW / RW / RQ 5Q 6Q. 7E / 8Q (7 6 7 8)

GPALEST    TU ES PETRUS                                 CASIMIR  26/001
|G |M$                 XRW / RH RQ 3Q / 4 5 6 (5 4) / 5Q 6

GPALEST    TU ES PETRUS                                 CASIMIR  26/001
|G |M$                 XRW / RH RQ 3Q / 4 5 6 (5 4) / 5Q 6

GPALEST    IN ILLC TEMPORE                              CASIMIR  27/001
             34        3Q 3 3 / 4H 5Q / 6Q (5 4) 5Q / 6Q

GPALEST    VELLC CI GEDEON, CUI DIO SI                  CASIMIR  22/057
|G |K1- |M$            6Q 6E 6 7Q 8 / 9 9 8 8 / 7HJ 8Q. 9E /

JARCDLT    MISSA AVE REGINA COELORUM                    CMM/C31  24-55
|G |K1- |M$            2Q. 3E 4Q 5J / 5Q (4 3) 4Q 5

JARCDLT    MISSA AVE REGINA COELORUM                    CMM/C31  24-55
|G |K1- |M$            RW / RW / 2Q. 3E 4Q 5J / 5Q (4 3) 4Q 5


|G |MC|                1Q. ((2 3)) 4Q 3E 2 / 3Q 4

                         XRB 1W. 2+Q 3+Q 4W. 3*H 2H 3 4H.

|5C |M$                3W 3 4 5 6 5 4 4 5 6

GPALEST    SALVE REGINA                                 CASIMIR  28/185
|G |K1- |M$            2+W / 3H. 4Q / 5 5 4 3 / 4WJ / 4H 4 / 5H.

GPALEST    MAGN. SEXTI TONI III 6V                      CASIMIR  16/260
|G |K1- |M$            RW / 2W / 3H 4 / 4 4Q 4 / 5H. 4Q / 3H 4Q 5 /

GPALEST    PAPAE MARCELLI                               CASIMIR  04/167
|G |M$                 7W / 8H 8 / 9 30J / 30Q (9 8) 9H / 30Q

GPALEST    PATER NOSTER                                 CASIMIR  08/001
|G |K1- |M$            XRW / 5W / 6 / 7H 7Q 7 / 8 7 6Q. 7E / 8Q


|G |MC|                RH 20W 20H / RH 20H 1-H 2H / 3W. 2+H / RH 1W  1  / R

|G |M$                 RW RW RW 3W 4 5H 6H. (5 4) 5H 6

|G |M$                 XRW RH 3W 4 5H 6H. (5 4) 5H 6

|G |M$                 XRW RH 19W 20 1H 2H. (1 20) 1H 2
```

```
+02+02+02-02-02+02+02 0405 023114          HL

+02+02+02-02-02+02+02 0305 011800          HL

+02+02+02-02-02+02+02 0405 011800          HL

+02+02+02-02-02+02+02 1316 012470          HL

+02+02+02-02-02+02+02 1418 012470          HL

+02+02+02-02-02+02+02 0104 012481          HL

+02+02+02-02-02+02+02 0305 012120          HL

+02+02+02-02-02+02+02 0205 003506          HL

+02+02+02-02-02+02+02 0305 003506          HL

+02+02+02-02-02+02+02 0205 023078          HL

      +02+02+02-02-02+02+02 0713 022567          HL

      +02+02+02-02-02+02+02 0304 000571          HL

      +02+02+02-02-02+02+02 0204 012679          HL

      +02+02+02-02-02+02+02 0104 011595          HL

      +02+02+02-02-02+02+02 0406 010304          HL

      +02+02+02-02-02+02+02 0505 010537          HL

      +02+02+02-02-02+02+02 0305 023106          HL
1   / RH 1H 2 3 / 4W. 3+H
      +02+02+02-02-02+02+02 0106 021703          HL

      +02+02+02-02-02+02+02 0506 021703          HL

      +02+02+02-02-02+02+02 0206 021703          HL
```

APPENDIX D

Page of computer printout showing merging of titles from various collections of music and poetry.

```
IANDRE    MILLE SCORGO LA SU FACI IMMORTALI                1605      SONNET
IANDRE    MILLE STRALI D'  AMOR NEL PETTO A                1605      SONNET
CGESUAL   MILLE VOLTE                                  EIN2404             HL007741
GFERNTE   MIRA CRUDA MIA                               EIN1103             HL006592
MGAGLNO   MIRA FILLIDE MIA                             EIN2304             HL007602
 MORO     MIRA SENZA PECCATO                             2DOR STIM609     MADRIG
 MORO     MIRA SENZA PECCATO                             AMOR STIM609     MADRIG
ABRUNI    MIRA,  AMOR, SE PUR CIECO HOGGI N              LE TRE GRATI     SONNET
PBENDTI   MIRAR LE FRESCHE ROSE                        EIN0705             HL006200
ABRUNI    MIRASTE IN TERRA,  ALMA REAL, DEL              LE TRE GRATI     SONNET
PBENDTI   MIRATE IN SUI MATTIN                         EIN0704             HL006179
 AGZARI   MIRO DEL SANGUE                              EIN0102             HL005525
IANDRE    MIRO IN GENTIL LUCIDO VETRO ACCOL                1605      SONNET
GLOMASO   MIRO VAGA FANCIULLA ALTIERA E BEL                RIME/1587
JFOGLNO   MISER CHI IN AMAR                            EIN2004             HL007363
 MORO     MISER'   ALMA INFELICE                         AMOR STIM609     MADRIG
 MORO     MISER'   ALMA INFELICE                         AMOR STIM609     MADRIG
 ANON     MISERA A CHI MAI PIU CREDER,                   NEWMAN,INDEX     MADRIG
CFRBSCO   MISERA CHE FARAI IN                          EIN1804             HL007222
 ANON     MISERA CHE FARO, PIANGERO SEMPRE               NEWMAN,INDEX     MADRIG
IANDRE    MISERA IO CHIAMO PUR, MA CHIAMO I                1605      SONNET
ACIFRA    MISERA NON CREDEA                            EIN1205             HL006707
IANDRE    MISERA PRIA SARA CALDA LA NEVE                   1605      SESTIN
 MORO     MISERA SPOGITA FRALE                           AMOR STIM609     MADRIG
GTASSO    MISERA  NON CREDEA CH'AGLI OCCHI               NEWMAN,INDEX     MADRIG
DBRUNET   MISERABIL MIO COR                            EIN1004             HL006487
GANERIO   MISERE TURBE                                 EIN0113             HL005565
 ANON     MISEREMINI MEI                                 NEWMAN,INDEX     MADRIG
GPALEST   MISERERE NOSTRI, DOMINE                      11/023       CASIMIR HL010763
 MARINO   MISERO  ALCEO DAL CARO ALBERGO FO               NEWMAN,INDEX     MADRIG
IANDRE    MISERO BEN M'ACCORGO                             1605      MADRIG
LBATI     MISERO CHE FARO                              EIN0602             HL006027
MGAGLNO   MISERO CHE SPERAVA                           EIN2304             HL007598
 MORO     MISERO CORE, PERCHE AMBISCI IN TE              AMOR STIM609     MADRIG
MMORO     MISERO INCAUTO COR, E NON TI SPET              AMOR STIM609     MADRIG
GFERETI   MISERO ME                                    EIN1807             HL007263
GLOMASO   MISERO ME CHE MAI NON POTEI DARE                RIME/1587
IGERO     MISERO ME CHE PER AMAR ALTRUI                34           541/14 MADRIGHL016032
 ANON     MISERO ME DOLENTE                              NEWMAN,INDEX     MADRIG
MMORO     MISERO ME GRAN TEMPO IO FUI DI GH              AMOR STIM609     MADRIG
GPALEST   MISERO STATO                                 02/099       CASIMIR HL010146
JARCDLT   MISS NOE NOE                                 1 - 23       CMM/031 MASS  HL003505
JARCDLT   MISS NOE NOE                                 1 - 23       CMM/031 MASS  HL003503
JARCDLT   MISS NOE NOE                                 1 - 23       CMM/031 MASS  HL003501
JARCDLT   MISS NOE NOE                                 1 - 23       CMM/031 MASS  HL003502
JARCDLT   MISS NOE NOE                                 1 - 23       CMM/031 MASS  HL003504
 ANON     MISSA  IO MI SON GIOVINETTA                    NEWMAN,INDEX     MADRIG
 ANON     MISSA  PAPAE  MARCELLI                         NEWMAN,INDEX     MADRIG
 ANON     MISSA "  IO MI SON GIOVINETTA"                 NEWMAN,INDEX     MADRIG
 ANON     MISSA "  L'  HOMME ARME"                       NEWMAN,INDEX     MADRIG
 ANON     MISSA "  PRAETER RERUM SERIEM"                 NEWMAN,INDEX     MADRIG
JARCDLT   MISSA AVE REGINA COELORUM                    24-55        CMM/031 MASS  HL003509
JARCDLT   MISSA AVE REGINA COELORUM                    24-55        CMM/031 MASS  HL003506
```

APPENDIX E

Instructions to contributors to data bank showing correct preparation of data for submission to computer.

STATE UNIVERSITY OF NEW YORK AT BINGHAMTON

COMPUTER CENTER

PROGRAM NAME:	RF--	ALIAS:	none
COMPUTER:	IBM 360/40	SYSTEM:	O.S.
LANGUAGE:	COBOL F	PROGRAMMER:	Cay Gill
RELEASE DATE:		DOCUMENTATION:	Available upon request

Abstract

All RF-- programs are designed according to specifications provided by Dr. Harry Lincoln. These programs create, process, maintain, and analyze a Master File containing Ford-Columbia music notation, interval sequences, basic information such as composer, title and source, and comments.

Two master files are maintained - one in serial-identification order and one in interval-sequence order.

RF-- programs are written in COBOL or are utility programs such as sort/merge. They obsolete all previous programs which were written in FORTRAN and Basic Assembler.

As of June 1, 1968, a master file containing approximately 15,000 records had been processed by the FORTRAN and BAL programs. Data was contributed by Harry Lincoln and 4 other musicologists. The output has resulted in several publications by the musicologists.

For additional information, contact:

Dr. Harry Lincoln
Department of Music
SUNY at Binghamton
Bingnamton, N.Y. 13901

RF-- PROGRAMS

RF01 - sorts L/P cards

RF02 - creates master records; can also be used as a validity check only

RF03 - merges RF02 output with the master file in serial number order

RF04 - sorts RF02 output in interval sequence and merges results with the master file in interval sequence order

RF05 - sorts B and C cards

RF06 - adds B cards to the master file in serial number order

RF07 - adds C cards to the master file in serial number order

RF08 - field selects, formats, and prints from any master file

RF09 - field selects, formats, and punches from any master file

RF10 - given one interval sequence, program extracts, from the master file in interval sequence order, all matches and "close" matches

Additional analysis programs are planned.

RF01 - Sort L/P Cards

RF01 sorts L/P cards for use as input to RF02. The cards must be stored on tape according to the following specifications:

```
DCB=(LRECL=80,RECFM=FB,BLKSIZE=1600,DEN=2,TRTCH=C)
```

Output is on tape with the same specifications.

The following cards are required for RF01:

```
//jobname  JOB  MSGLEVEL=1
//STEP EXEC RF01,TPIN=TPxxx,TPOUT=TPxxx     (xxx - tape numbers)
//CTLCD DD *
   SORT FIELDS=(s,l,CH,A,sv,lv,CH,A,80,1,CH,A),SIZE=Ennnn
/*
```

where: s is the starting column of the serial number
l is the length of the serial number
sv is the starting column of the voice code
lv is the length of the voice code (must be 4)
nnnn is an estimate of the number of records to be sorted

If the records do not contain voice codes, the specifications for the sort are:

```
SORT FIELDS=(s,l,CH,A,80,1,CH,A),SIZE=Ennnn
```

RF02 - Master File Creation

RF02, written in COBOL, processes Ford-Columbia codes to extract the first seven intervals.

Melody (M) cards and/or master records can be created by RF02. M cards contain the interval sequence, some basic information, and serial identification. There is no option on the format of the M card; if an M card in a format other than that described in the RF02 documentation is desired, use RF09.

Input to RF02 is a set of L/P cards which have been sorted by RF01.

L/P cards must contain Ford-Columbia codes, serial identification, and an L or a P in column 80. Optional input consists of Basic (B) cards and/or Comments (C) cards. B and C cards must be sorted using RF05.

Incorporated in the program are a number of validity checks. The program can be used simply to check the data; all other output is suppressed. (The validity checks in the program do <u>not</u> replace proofreading; cards should be listed and proofread immediately upon completion of keypunching.) The master record option must not be exercised until the data has been proofread and validity checked and <u>all</u> errors corrected.

The following topics are included in this documentation of RF02:

Preparation of input: L/P cards, B cards, C cards, RF02 control card
Error messages
Description of output: Master Record, M cards
Deck setup for RF02

PREPARATION OF INPUT - RF02

L/P Cards

The information which can be processed from an L/P card, is:

Clef notation (optional)
Ford-Columbia codes (required)
Comments (optional)
Card number (optional)
Voice code (optional)
Serial identification (required)
L or P in column 80 (required)

Each incipit is coded on one or more L/P cards. All cards except the last contain an L in column 80; the last or only card contains a P in column 80.

The format for an L/P card is variable. The following specifications must be considered when deciding on a format for a batch of L/P cards: All cards to be processed by any one run of RF02 must have the same format. The format specifications are coded on the RF02 control card.

Clef notation:
- a maximum of 15 consecutive columns can be used; notation must appear in the first or only card for the incipit
- the columns used for the clef notation will be ignored in all other cards for the incipit
- consult Dr. Lincoln for details on coding clef notations

Ford-Columbia codes:
- there is no restriction on the number of columns used for F-C codes on any one card except that the same number be used on each card
- a maximum of 160 columns can be used for F-C codes
- therefore, the number of cards required for an incipit is a function of the length of the F-C codes
- if the entire F-C field is not required on the last card, the remaining columns must be blank
- consult Dr. Lincoln for details on Ford-Columbia codes

Comments:
- a maximum of 10 columns can be used
- a comment must appear in the first or only card for the incipit
- the columns used for the comments will be ignored in all other cards for the incipit
- up to 80 columns of comments can be accepted from a C card; the "short" comment field on the L/P card is useful for alternate serial numbers or any other identifying information not allowed for in the layout of the L/P card

Card number: recommended; if omitted, L/P cards cannot be sequence checked
one column field; same column in all cards
cards must be numbered consecutively beginning with 1
since a P in column 80 signals the last card for the incipit, the sequence number in the P card is the number of cards coded for the incipit.

Voice code: must be used if more than one voice is being coded; i.e., the same serial identification will appear in more than one set of L/P cards
must be 4 columns; same columns in all cards
if any set of L/P cards contain a voice code, all cards in the batch of RF02 input must contain 4 columns for the code; if there is no code, leave the field blank
an example of a voice code is 0204 which means the second of 4 voices; voice codes must be in that format; the zeros must be punched for sorting purposes

Serial identification:

a maximum of 15 columns can be used
the identification can be alphameric
it is each user's responsibility to ensure unique serial identifications within his set of data; a researcher code in each record permits more than one user to have the same serial identification for a composition
blanks within a serial will be transformed to zeros for sorting purposes
consult Dr. Lincoln on the subject of serial identification

L or P: must be in column 80 of every card
L in all cards except the last
P in the last or only card for an incipit

Summary - L/P cards

The minimum requirements are: Ford-Columbia codes, serial identification and an L or a P in column 80.

The fields described above can be in any order.

All cards in a batch of RF02 input must have the same format and must have been prepared by the same researcher.

Basic (B) Cards

The information which can be processed from a B card is:

Composer - maximum is 10 columns
Title - maximum is 35 columns
Source - maximum is 9 columns
Page - maximum is 10 columns
Genre - maximum is 7 columns

Serial identification: maximum is 15 columns
must be the same length as in the L/P cards

The layout of the B card is specified in the RF02 control card. All B cards must have the same format.

The format for a B card is variable; the fields can be in any order. There should be only one B card for each serial identification. Before being used as input to RF02, the file should be sorted using RF05.

If the file contains a card with a serial identification which does not match any L/P serial identification, B card is ignored. No message is produced by RF02.

If there is no match in the B-card file for an L/P set, RF02 produces a message which provides the serial identification of the L/P set.

B cards can also be inserted in the master file by RF06.

Comments (C) Cards

C cards contain a serial identification and any other information the user wishes to supply.

Serial identification: maximum is 15 columns
must be same length as in the L/P cards

Comment: maximum is (80 - length of serial identification)
comment must be coded consecutively; i.e., the serial identification must not appear in the midst of the comment

The comment can precede or follow the serial identification. The layout of the C card is specified in the RF02 control card. All C cards must have the same format.

There should be only one C card for each serial identification. Before being used as input to RF02, the file should be sorted using RF05.

If the file contains a card with a serial identification which does not match any L/P serial identification, the C card is ignored. No message is produced by RF02.

If there is no match in the C-card file for an L/P set, RF02 produces a message which provides the serial identification of the L/P set.

C cards can also be inserted in the master file by RF06.

RF02 CONTROL CARD

Cols.	Contents
1- 2	MC if Melody (M) cards are desired; otherwise, leave blank
3- 4	TP if master records are desired; otherwise, leave blank
5- 6	Number of the column in which the card number appears (sequence check option); if the L/P cards were not numbered, leave blank
7- 8	Number of the column in which the clef notation starts; leave blank if clef notation was not coded
9-10	Number of columns used for the clef notation; leave blank if clef notation was not coded
11-12	Number of the column in which the Ford-Columbia codes start
13-14	Number of columns used in each card for Ford-Columbia codes
15-16	Researcher code - assigned by Dr. Lincoln
17-18	Number of the column in which the voice code starts; leave blank if voice codes were omitted
19-20	Number of the column in which the serial identification starts
21-22	Number of columns used for the serial identification
23-24	Number of the column in which the comment on the L/P card starts; leave blank if no comment was coded
25-26	Number of columns used for the comment in the L/P card; leave blank if no comment was coded
27-28	CC if Comments (C) cards are supplied; otherwise, leave blank
29-30	Number of the column in which the comment in the C card starts; leave blank if no C cards are supplied
31-32	Number of columns used for the comment in the C card; leave blank if no C cards are supplied
33-34	Number of the column in which the serial identification in the C card starts; leave blank if no C cards are supplied
35-36	BC if Basic (B) cards are supplied; otherwise, leave blank
37-38	Number of the column in which the serial identification in the B card starts; leave blank if no B cards are supplied

39-40 Number of the column in which the composer field starts; leave blank if no B cards are supplied or if the composer field in the B card is omitted

41-42 Number of columns used for the composer field; leave blank if no B cards are supplied or if the composer field in in the B card is omitted

43-44 Number of the column in which the title starts; leave blank if no B cards are supplied or if the title field in the B card is omitted

45-46 Number of columns used for the title; leave blank if no B cards are supplied or if the title field in the B card is omitted

47-48 Number of the column in which the source field starts; leave blank if no B cards are supplied or if the source field in the B card is omitted

49-50 Number of columns used for the source field; leave blank if no B cards are supplied or if the source field in the B card is omitted

51-52 Number of the column in which the page field starts; leave blank if no B cards are supplied or if the page field in in the B card is omitted

53-54 Number of columns used for the page field; leave blank if no B cards are supplied or if the page field in the B card is omitted

55-56 Number of the column in which the genre field starts; leave blank if no B cards are supplied or if the genre field in the B card is omitted

57-58 Number of columns used for the genre field; leave blank if no B cards are supplied or if the genre field in the B card is omitted

NOTES: For validity checking only, leave columns 1-4 blank.

If no C cards are supplied, leave columns 27-34 blank.

If no B cards are supplied, leave columns 35-58 blank.

RF02 MESSAGES

Message	Action
NO RESEARCHER CODE: RUN CANCELLED.	Supply researcher code in cols. 15-16 of RF02 control card.
F/C LENGTH IS 0; RUN CANCELLED.	Supply length of Ford-Columbia codes in cols. 13-14 of RF02 control card.
SERIAL NO. LENGTH IS 0; RUN CANCELLED.	Supply length of serial identification in cols. 21-22 of RF02 control card.
SERIAL NO. LENGTH 15; SERIAL NO. TRUNCATED.	None
CLEF NOTATION LENGTH 15; CLEF NOTATION TRUNCATED.	None
L/P COMMENT LENGTH 10; COMMENT TRUNCATED.	None
C-CARD COMMENT LENGTH + SERIAL IDENTIFICATION LENGTH 80; COMMENT TRUNCATED.	None
COMPOSER LENGTH 10; COMPOSER TRUNCATED.	None
TITLE LENGTH 35; TITLE TRUNCATED.	None
SOURCE LENGTH 9; SOURCE TRUNCATED.	None
PAGE LENGTH 10; PAGE TRUNCATED.	None
GENRE LENGTH 7; GENRE TRUNCATED.	None
TOTAL F/C LENGTH 160; RUN CANCELLED	Check length specification in cols. 13-14 of RF
MORE THAN 160 F/C CODES FOR voice code serial identification; INCIPIT NOT PROCESSED.	Correct the error before exercising the master record option.
INTERVAL +18 FOR voice code - serial identification +18 ASSUMED.	Possible error; check cards before exercising master record option.
INTERVAL -18 FOR voice code - serial identification -18 ASSUMED.	Possible error; check cards before exercising master record option.

POSSIBLE ERROR - LESS THAN 7 INTERVALS FOR voice code - serial identification.	Check cards before exercising the master record option.
NO NOTE NOTATION FOR: voice code - serial identification.	Possible error; program looks for the first note notation for sorting purposes; check cards before exercising the master record option.
voice code - serial identification OUT OF SEQUENCE: INCIPIT NOT PROCESSED.	Either a card is missing or a card number is mispunched; check cards before exercising the master record option.
MISSING P CARD FOR LAST SERIAL: voice code - serial identification; INCIPIT NOT PROCESSED.	Correct the error before exercising the master record option.
NO FIRST COLUMN SPECIFICATION FOR B CARD SERIAL IDENTIFICATION. B CARDS NOT PROCESSED.	Either correct cols. 37-38 of RF02 control card and rerun or use RF06 to insert B cards.
NO FIRST COLUMN SPECIFICATION FOR C CARD SERIAL IDENTIFICATION. C CARDS NOT PROCESSED.	Either correct cols. 33-34 of RF02 control card and rerun or use RF07 to insert C cards.
NO B CARD FOR serial identification.	None
END OF FILE ON B CARDS. serial identification WAS LAST SERIAL PROCESSED.	None
NO C CARD FOR serial identification.	None
END OF FILE ON C CARDS. serial identification WAS LAST SERIAL PROCESSED.	None
MISSING CARD: FOLLOWING CARDS IGNORED: print-out of the last2 L/P cards read	Correct the error before exercising the master record option.
RF02 - END OF JOB.	None.

DESCRIPTION OF OUTPUT

The following pages show the layout of the master record and the Melody (M) card.

Fields not supplied in the input are left blank on the master record and in the M card.

The interval sequence in the master record can best be illustrated by an example:

+02-03-02+08-11+04+15

On the M card it would appear as:

+2-3-2+8-D+4+K

The interval sequence is reduced to 14 columns on the M card so that it can also contain B card information. Intervals between 10 and 18 are punched as follows:

+10 - A	-10 - B
+11 - C	-11 - D
+12 - E	-12 - F
+13 - G	-13 - H
+14 - I	-14 - J
+15 - K	-15 - L
+16 - M	-16 - N
+17 - O	-17 - P
+18 - Q	-18 - R
+19 - S	-19 - T

FILE NO.	FILE NAME
	RF--. Master Record

FILE SPECIFICATIONS		PREPARED BY	DATE
☒ FIXED RECORD LENGTH	☐ VARIABLE RECORD MAX. LENGTH 400		
☒ FIXED BLOCKING 4000		☐ VARIABLE LENGTH BLOCK MAXIMUM LENGTH	
HEADER ☐ STANDARD ☐ NON-STANDARD		TRAILER ☐ STANDARD ☐ NON-STANDARD	
DATA CHARACTERISTICS ☐ BINARY ☒ DECIMAL ☐ OCTAL		MODE ☐ LOAD ☐ MOVE	

FILE IS OUTPUT OF	FILE IS INPUT TO
RF02	

SEQ.	COUNT	POSITIONS FROM	POSITIONS TO	TYPE	FIELD DESCRIPTION	
	15	15	1	15	CLEF NOTATION	M-CLEF
		160	21 16	175	FORD-COLUMBIA CODES	M-FC
	2	2	181 176	177	RESEARCHER ID	M-RCH
		15	189 178	192	SERIAL NUMBER	M-SERIAL
		4	198 193	196	VOICE CODE	M-VOICE
		10	202 197	206	COMPOSER	M-COMP
		35	212 207	241	TITLE	M-TITLE
		9	249 242	250	SOURCE	M-SOURCE
304 80		10	255 251	260	PAGE	M-PAGE
314		7	266 261	267	GENRE	M-GENRE
		21	273 268	288	INTERVAL SEQUENCE	M-INTERVAL
		10	289	298	COMMENTS FROM L/P CARD	M-COMMENT-LP
		80	304 299	378	COMMENTS FROM C CARD	M-COMMENT-C
		14	379	392	RESERVED FOR EXPANSION	M-FILLER
		8	393	400	SORT FIELD	M-SORT

FORMAT DESCRIPTION SHEET PAGE ____ OF ____

FILE NO.	FILE NAME: Melody Card		
FILE SPECIFICATIONS ☐ FIXED RECORD LENGTH ☐ VARIABLE RECORD MAX. LENGTH		PREPARED BY	DATE
☐ FIXED BLOCKING		☐ VARIABLE LENGTH BLOCK MAXIMUM LENGTH	
HEADER ☐ STANDARD ☐ NON-STANDARD		TRAILER ☐ STANDARD ☐ NON-STANDARD	
DATA CHARACTERISTICS ☐ BINARY ☐ DECIMAL ☐ OCTAL		MODE ☐ LOAD ☐ MOVE	
FILE IS OUTPUT OF	FILE IS INPUT TO		

SEQ.	COUNT	POSITIONS FROM	POSITIONS TO	TYPE	FIELD DESCRIPTION	
	6	1	6		COMPOSER	MEL-COMP
	1	7	7			
	12	8	19		TITLE	MEL-TITLE
	1	20	20			
	6	21	26		GENRE	MEL-GENRE
	1	27	27			
	14	28	41		INTERVAL SEQUENCE	MEL-INTERVAL
	1	42	42			
	6	43	48		SOURCE	MEL-SOURCE
	1	49	49			
	10	50	59-		PAGE	MEL-PAGE
	4	60	63		VOICE CODE	MEL-VOICE
	2	64	65		RESEARCHER CODE	MEL-RCH
	15	66	80		SERIAL	MEL-SERIAL

DECK SETUP FOR RF02

```
//jobname JOB MSGLEVEL=1
//JOBLIB DD DSNAME=SYS1.ACAD,DISP=OLD
//STEP EXEC RF02,LP=TPxxx,MT=TPxxx          (xxx - tape numbers)
//CTLCD DD *
    supply RF02 control card
/*
```

APPENDIX F

Example of printout from program to compute broad contour of a melody from detailed contour.

```
+2+2+2-2-2-2-2   1C4   HL0076   + 3- 4
+2+2+2-2-2+2+2   1C4   HL0127   + 3- 2+ 2
+2+2+2+2-2+2-3   1C4   HL0129   + 4- 1+ 1- 2
+2+2+2-2-2-2+4   1C4   HL0131   + 3- 3+ 3
+2+2-2+2-3+2-2   1C4   HL0133   + 2- 1+ 1- 2+ 1- 1
+2+2+2+2-3-2+2   1C4   HLC144   + 4- 3+ 1
+2+2+2-3-2-3-2   1C4   HL0145   + 3- 6
+2+2-2-2-2+2+2   1C4   HLC146   + 2- 3+ 2
+2+2+2-2-2+2+2   1C4   HL0150   + 3- 2+ 2
+2+2+2+2-3-2+2   1C4   HLC158   + 4- 3+ 1
+2+2+2+2-2+2-2   1C4   HLC159   + 4- 1+ 1- 1
+2+2+2+2+2-2+2   1C4   HLC166   + 5- 1+ 1
+2+2-2+3-2+2+3   1C4   HLC176   + 2- 1+ 2- 1+ 3
+2+2-2+2-2+2+2   1C4   HLC181   + 2- 1+ 1- 1+ 2
+2+2+2+2+2-2+3   1C4   HLC227   + 5- 1+ 2
```

APPENDIX G

Example of output from "Merit Function Program"

```
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-2  FACTOR IS   4
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-2  FACTOR IS   4
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-2  FACTOR IS   4
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-2  FACTOR IS   4
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-2  FACTOR IS   4
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-2  FACTOR IS   4
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-2  FACTOR IS   4
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-2  FACTOR IS   4
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 3  FACTOR IS   6
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 3  FACTOR IS   6
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 3  FACTOR IS   6
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 3  FACTOR IS   6
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-3  FACTOR IS   3
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 4  FACTOR IS   9
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 4  FACTOR IS   9
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 4  FACTOR IS   9
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 4  FACTOR IS   9
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 4  FACTOR IS   9
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 4  FACTOR IS   9
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-4  FACTOR IS   2
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-4  FACTOR IS   2
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2-4  FACTOR IS   2
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 5  FACTOR IS   6
3 2 2-2-2-2 4 COMPARED WITH  2 2 2-2-2-2 5  FACTOR IS   6
```

APPENDIX H

List of participants in Conference on Thematic Indexing, Washington, D.C., November 1968.

Conference on Thematic Indexing by Computer

Mayflower Hotel
Washington, D.C.
November 4, 1967

PARTICIPANTS

Professor Lawrence Bernstein, Department of Music, University of Chicago.
Mr. Fred Blum, Librarian, Catholic University of America. (Formerly Music Division, Library of Congress).
Mrs. Andrew W. Edson, Washington, D.C.
Rev. Leonard Ellinwood, College of Church Musicians, Washington Cathedral.
Professor Harry Eskew, Baptist Theological Seminary, New Orleans.
Professor Frederick Freedman, Music Library, Vassar College.
Professor Barton Hudson, Department of Music, West Virginia University.
Professor Earle Hultberg, State University College, Potsdam, N.Y.
Professor Jan LaRue, New York University. (President, American Musicological Society).
Dr. Paul Lehman, Music Education Specialist, Arts and Humanities Program, U.S. Office of Education.
Professor John Nagosky, Department of Music, South Florida University.
Dr. Benjamin Suchoff, Curator, The Bela Bartok Archives, New York, N.Y.
Dr. Ruth Watanabe, Sibley Library, Eastman School of Music. (Chairman, Committee on Thematic Indexing of the Music Library Association).
Dr. Thomas Willis, Music Critic, Chicago Tribune.
Mr. Irving Lowens, Music Critic, Evening Star, Washington, D.C. (Formerly Head, Music Division, Library of Congress).
Professor Franklin Zimmerman, Department of Music, University of Kentucky.

Professor Harry B. Lincoln, Department of Music, State University of New York at Binghamton. Chairman of the Conference.